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Shock Hugoniot Behavior of Mixed Phases With Widely Varying Shock Impedances

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The shock velocity dependence on shock pressure in composite explosive materials containing polymeric materials is known[1] to exhibit marked non-linear behavior in the U_s - u_p plane at low pressures. This is in addition to the non-linear behavior noted[2] in pure polymeric materials. The precise description of this behavior is important in analyzing the response of energetic materials to impact shocks.

We will show that the mismatch of the shock impedances in such materials as rocket propellants composed of polymer binder, aluminum, and ammonium perchlorate can be expected to exhibit a very large initial slope of the shock velocity, U_s dependence on the particle velocity, u_p. This slope is simply a result of the equilibration of Hugoniot pressure amongst the phases. With accurate descriptions for the equations of state of the individual components, we successfully predict the extreme slope at low compression. The effect is primarily due to the very large compression of the polymeric phase at relatively low volumetric compression of the whole mixture. Examples are shown and compared with available experimental results.

1) W. J. Carter and Stanley P. Marsh, "Hugoniot Equation of State of Polymers", LA-13006-MS, July 1995.

2) R. R. Bernecker, "Observations on Hugoniots of Elastomeric Binder Systems:, JANNAF Meeting of the Propulsion Systems Hazard Subcommittee, 1995.

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